W31a Modeling Circumstellar Disk Emission near Periastron in the Be/Gamma-Ray Binary PSR B1259−63/LS 2883

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Gamma-ray binaries are a subclass of high-mass X-ray binaries, in which the optical counterpart is either an O-type star or a Be star with a circumstellar disk. PSR B1259-63/LS 2883 is the first such system confirmed to host a pulsar with a relativistic wind. It consists of a Be star and a pulsar in a highly eccentric ($e = 0.87$), long-period ($P_{\rm orb} = 3.4$ yr) orbit. At each periastron passage, the system exhibits double-peaked light curves across radio, X-ray, and TeV bands, attributed to synchrotron and inverse Compton emission from pulsar wind shocks (e.g., Chernyakova+ 2024). In contrast, emission from the Be disk shows variability at mm (e.g., Fujita+ 2024), near-infrared (Kawachi+ 2021), and optical wavelengths (e.g., van Soelen+ 2016), including enhanced Hα emission lasting 30 days after periastron. The physical origin of this disk variability remains unclear.

In this presentation, we report modeling results of the disk emission from PSR B1259-63/LS 2883. We conducted 3D SPH simulations of the interaction between the pulsar wind and the Be star's disk and wind. Using the SPH outputs, we then performed 3D Monte Carlo radiative transfer simulations with the HDUST code (Carciofi & Bjorkman 2008). The simulated Hα and NIR emission show temporal variations consistent with observations. We find that the Hα variability arises mainly from disk deformation by the pulsar wind, whereas the NIR variability is primarily due to tidal interaction.